tion of the twenty-nine known species (Hymenoptera: Formicidae). Aust. J. Zool. 27: 773–788.

Taylor, R. W. 1990. New Asian ants of the tribe Basicerotini, with an on-line computer interactive key to the twenty-six known Indo-Australian species (Hymenoptera: Formicidae: Myrmicinae). Invert. Taxon. 4:397–425.

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Handbook of the Fruit Flies (Diptera: Tephritidae) of America North of Mexico.— R. H. Foote, F. L. Blanc and A. L. Norrbom. 1993. Comstock Publishing Associates (a division of Cornell University Press), Ithaca. xii + 571 pp. US $115.50 cloth.

In the field of agriculture, the true fruit flies (Tephritidae or Trypetidae) are by far the most written about and researched group of Diptera, with citations far in excess of the other major phytophagous groups, namely the Cecidomyiidae and Agromyzidae. Most of that interest is confined to the major fruit pest genera *Anastrepha, Bactrocera, Ceratitis, Dacus* and *Rhagoletis,* all of which have been found in North America at some time, even if they are fortunately not all established there. However, most temperate members of the family are not associated with fruit, but with the flowers, or sometimes leaves, stems or roots, of Asteraceae (=Compositae). Most of the 300 species and 56 genera known in North America are Asteraceae-associated, and some of those are actually European species deliberately introduced to help control European plants that have been accidentally introduced into North America. The application of these flies to weed biological control has been possible because most of the Asteraceae-associated tephritids have a remarkably narrow host range, in many cases attacking only a few plants belonging to a single species group, subgenus or genus. Complex behavioral patterns in mate recognition and the use of the host plant as a mating rendezvous site have no doubt facilitated the evolution of many closely related species each with differing ranges of hosts. However, the family Tephritidae has been remarkably neglected by the major workers in plant–insect relationships, and most of our knowledge of the biology of the Asteraceae-associated species comes from the work of present or former biocontrol specialists.

This monumental work, which deserves a more prestigious title than merely *Handbook,* keys and describes all of the 300 species known from the Americas north of Mexico. It will therefore enable identification of the known pest and beneficial species, and hopefully encourage further work involving these flies in the field of plant–insect relationships. For the first two authors this book represents a synthesis of experience gained during entire career spans, supplemented by recent studies carried out by the third author, notably on the genus *Anastrepha.*

The book starts with an introduction which includes a mention of species of some biocontrol agent tephritids that were introduced too late for full inclusion in the work. There follows an excellent account of the adult morphology of tephritid fruit flies which is both well illustrated and applies the standardized terms first detailed in the *Manual of Nearctic Diptera* (J. F. McAlpine, ed., 1981). Even so, there is still

some confusion over the application of these terms as the authors use the term post-alar for what I have called posterior supra-alar; and others have used post-alar for what the authors (and myself) have called the intra-alar. So much for standardization! The next section, covering biology, is very brief, but excusably so with so many fruit fly symposium volumes and multi-author works covering every worked aspect of tephritid biology, to refer to. The authors then present a review of the classifications of the family, including the first ever tabulation showing how the North American genera fit into the classification. This section is of importance to fruit fly taxonomists in all world regions as it is the first detailed account of the work that Al Norrbom has been coordinating for the last few years to try to produce a sensible globally applicable classification of the family; no mean task in a family of just 4,000 species divided among a colossal 500 genera. The following section is also worldwide in coverage as it reviews the major taxonomic literature from each zoogeographic region. The next chapter, *Techniques for Study,* is an excellent account of how to mount and dissect specimens, but details of collecting and rearing techniques are sadly lacking. The final introductory section is entitled *About this Handbook,* and it explains the scope of the keys and species accounts. This section also lists nomenclatural changes made in the *Handbook,* and this is a particularly good idea as I always fear *Zoological Record* abstractors could miss changes made within a substantial text of this sort.

The first key is to genera, as the authors very wisely make no attempt to present a key to subfamilies and tribes. This, and other keys are very clearly illustrated with figures close to the text from which they are referenced, and with a system of lettered arrows to important features. Although I found it fairly obvious what the significance of the indicated features were in almost all cases, some readers may wish they had been explained in the figure legends as well as in the keys.

In the *Systematic Treatment of the Genera,* the genera and species are arranged in alphabetical order. The main genera covered that include pest species are *Anastrepha, Bactrocera, Ceratitis, Dacus* and *Rhagoletis.* The key to 19 *Anastrepha* spp., includes the West Indian fruit fly (*A.obliqua* (Macquart)), Sapote fruit fly (*A. serpentina* (Wiedemann)) and Guava fruit fly (*A. striata* Schiner), all of which have distributions which abut the southern borders of the USA and represent a considerable threat to the US fruit industry. The account of *Rhagoletis* spp. is also likely to be well used as this includes the most important temperate fruit pests in North America, e.g. the apple maggot fly (*R. pomonella* (Walsh)), which has also been the subject of extensive studies of speciation processes. Many *Rhagoletis* spp. are also of major plant quarantine importance to Europe, and in recent years two North American species have regularly been trapped in Switzerland.

Regrettably, the account of the *Bactrocera* spp. that have been intercepted or trapped in the USA could have been improved by review at the manuscript stage. No *Bactrocera* spp. are native to the New World, although the melon fly (*B. cucurbitae* (Coquillett)), Oriental fruit fly (*B. dorsalis* (Hendel)) and solanum fruit fly (*B. latifrons* (Hendel)) are all established in Hawaii, and a close relative of Oriental fruit fly is also established in Suriname. All of these species, plus the Queensland fruit fly (*B. tryoni* (Froggatt)) and two other Asian species, have been intercepted or bait-trapped in California. Fortunately none of these species have become established, but as it is important that good information on their recognition is made available, some amendments to the key are suggested here. Couplet 1 could have mentioned that the

melon fly is also separated from the other five species by having three, rather than two, stripes on the scutum. The Queensland fruit fly separates from the others by having its costal band start from the base of the wing rather than from cell sc, and then the solanum fruit fly can be separated from the Oriental fruit fly, by its yellow anepisternal stripe being triangular and contacting the yellow mark on the postpronotal lobe. Unfortunately, some of the wing photographs for this genus were based on teneral specimens, so the apical expansion of the costal band of the solanum fruit fly is not shown clearly. The authors have also chosen to perpetrate the USDA habit of calling this widespread Asian species Malaysian fruit fly, despite the fact that Malaysian agricultural entomologists voiced objections to this at a meeting I attended in Kuala Lumpur in the company of one of the authors! Naturally the Malaysians do not want to risk being singled out for fruit export bans that are equally applicable to neighboring countries.

The genera of particular importance for their inclusion of weed biocontrol agents of use in North America are *Chaetorellia, Tephritis, Terellia* and *Urophora.* All of the *Urophora* spp. of interest are included, although some of the distribution maps should show more Canadian records. Unfortunately the genera *Chaetorellia* and *Terellia,* both of which include species about to be released, or in some cases actually established in North America to help control some weedy *Centaurea* spp., are only mentioned in the introduction and are not described.

The remaining 49 genera lack species of notable economic importance, but nonetheless include a range of interesting, and in many cases very beautiful looking insects. Flies are generally underrated aesthetically, but having collected genera such as *Aciurina, Gymnocarena, Paracantha* and *Strauzia,* I can vouch for that fact that when alive, many of these North American flies have brilliant green and brown patterns across their eyes, which sparkle like jewels. A characteristic feature of the family Tephritidae is that most species have ornately patterned wings, and curiously, I suspect this has hindered proper understanding of species limits, as there has been a tendency to divide species on often trivial characters of wing pattern. While collecting in British Columbia I reared some specimens of a *Tephritis* sp. from flowers of an *Erigeron* sp. I also swept huge numbers of what I took to be a separate and consistently rather smaller species from areas where there was no *Erigeron.* Samples of both of these flies were sent to the authors of this *Handbook* for examination and both were identified as *T. araneosa* (Coquillett). Knowing the mess our European *Tephritis* fauna used be in as a result of the over-reliance on wing pattern, I remain skeptical of the conspecificity of those two populations. Consequently, I was very pleased that the authors mention in the introduction to the *Tephritis* section that "the results of future biological studies may alter our concepts at the special level," and that they also make special reference to problems associated with the concept of *T. araneosa.*

This excellent book will I hope spur North American entomologists on to make those biological studies, although the lack of a summary of existing host data appears at first sight to be a major omission. North America is the only region for which an extensive tephritid host catalogue has been published and the lack of a host list in the *Handbook* is therefore excusable. However, some of the host records that are quoted should have been subject to some scrutiny. For example, I find it very hard

to believe the record of *T. araneosa* from the grass *Poa,* since all confirmed rearings of *Tephritis* spp. have been from the Asteraceae.

It is regrettable that this book has clearly taken a long time between manuscript completion and publication. For example, a 1985 revision of *Orellia* and *Terellia* spp. apparently came too late to be applied to the arrangement of this 1993 publication. Similarly, recent revisions of *Epochra* and *Paroxyna* spp. could not be taken into account and I could find no mention of the recent outbreak of Mediterranean fruit fly (*Ceratitis capitata* (Wiedemann)) in California. Clearly, this delay would have been largely the fault of the publishers rather than the authors. Another feature which may be attributable to the publisher is that the illustrations are a little under-sized, although that is compensated for by their clarity and undoubted good quality. However, the distribution maps are not under-sized and give a very clear visual indication of the range of every species, although no distinction is made between established distribution and areas from which pest species have been eradicated.

Bearing in mind the diverse reasons for which the family Tephritidae is studied, this book should be of value in the field of plant quarantine and weed biocontrol, and it will be a major contribution to the study of North American Diptera, and in a wider context the taxonomy of Tephritidae. As I have already indicated, there is considerable scope for discovery in combining work on plant–insect relationships with the taxonomy of these delightful flies. Few works in taxonomy can rightfully claim such a wide potential audience.—*Ian M. White, International Institute of Entomology, 56 Queen's Gate, London SW7 5JR, U.K.*

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Insect Pathology.—Y. Tanada and H. K. Kaya. 1993. Academic Press, San Diego. 666 pp. $129.00.

That diseases can decimate insect populations has long been recognized, yet this subdiscipline of entomology has received relatively little attention until fairly recently. Effective biological control is in great demand; in systems where predators and parasitoids provide inadequate pest control, disease-causing organisms are now being evaluated and integrated into pest management. In fact, several microorganisms and nematodes are presently commercially available and quite a few more are in the registration process or are being developed for mass production. However, these developments demonstrate only the most readily foreseen applications of insect pathology. Research with insect pathogens has yielded major advances in entomology in the application of molecular biological methodology. For example, baculoviruses have been engineered to produce drugs for humans and crop plant varieties are protected by expression of the *Bacillus thuringiensis* delta-endotoxin gene. Studies of disease-causing organisms increase the basic knowledge in microbiology, protozoology, mycology, virology, and nematology as well as insect immunology. Application of computer models to patterns of disease abundance builds on generalized epidemiological theories toward developing the ability to predict disease prevalence.